II. REMARKS

Claim 4 has been cancelled without prejudice. Claims 1 and 2 have been amended, and new claims 5-14 have been added. Specifically, claim 1 has been amended to improve grammar, which has no further limiting effect on the scope of this claim. Claim 1 has also been amended to recite "wherein the oxide ceramics reinforcing liquid is impregnated in a pressure reduced vessel" as supported on page 6, lines 16-18, of the specification as originally filed. Claim 1 has been further amended to remove the "step-plus-function" language so as not to invoke 35 U.S.C. § 112, sixth paragraph, and which has a broadening effect on the scope of this claim. Claim 2 has been amended to improve grammar, which has no further limiting effect on the scope of claim 2.

New claims 5 depends upon independent claim 1, and additionally recites "wherein the ceramics reinforcing liquid is an inorganic binder, and during impregnation of the ceramic core the inorganic binder smoothly replaces air in the ceramic core" as supported on page 6, lines 13-20, of Applicants' specification as originally filed. New claim 6 depends upon claim 5 and additionally recites "wherein impregnation of the ceramic core with inorganic binder occurs over about 5 to 10 minutes" as supported on page 6, lines 20-21, of Applicants' specification as originally filed. New claim 7 depends upon independent claim 1, and additionally recites "wherein the resin-covered ceramic powder comprises zircon powder covered with a phenol resin or silica powder covered with the phenol resin" as supported on page 5, line 25, to page 6, line 1, of Applicants' specification as originally filed. New claim 8 depends upon independent claim 1, and additionally recites "confining the ceramic core in wax and then forming a heat-resistant shell around the ceramic core confined in wax" as supported on page 9, lines 2-9, of Applicants' specification as originally filed.

New independent claim 9 corresponds to previous independent claim 1 amended to improve grammar, and to recite "wherein the oxide ceramics reinforcing liquid is

impregnated in a pressure reduced vessel" as supported on page 6, lines 16-18, of the specification as originally filed. New claims 10-14 correspond to claims 2 and 5-8, but written to depend upon new independent claim 9.

The present amendment adds no new matter to the application.

A. The Invention

The present invention pertains broadly to a method of manufacturing a heat-resistant ceramic core with a three-dimensional shape as may be used to cast a hollow flow passage by precision casting. In an embodiment of the present invention, a method of manufacturing a heat-resistant ceramic core with a three-dimensional shape is provided that includes the steps recited by independent claim 1. In another embodiment of the present invention, a method of manufacturing a heat-resistant ceramic core with a three-dimensional shape is provided that includes the steps recited by independent claim 9. Various other embodiments, in accordance with the present invention, are recited in the dependent claims.

An advantage provided by the various embodiments of the present invention is that even if the shape of the ceramic core is complicated, it may still be easily manufactured. Another advantage provided by the various embodiments of the present invention is that a ceramic core formed by powder lamination is made more heat-resistant due to impregnation with ceramic reinforcing liquid and by sintering the impregnated ceramic core. In addition, as taught by the present specification at page 8, lines 1-2, sintering at 1100 degrees centigrade or more advantageously results in a material with high heat resistance.

B. The Rejections

Claims 1 and 2 stand rejected under 35 U.S.C. § 103(a) as unpatentable over Vail et al. (N.K. Vail et al., *Ceramic Structures by Selective Laser Sintering of Microencapsulated,*

Finely Divided Ceramic Materials, Solid Freeform Fabrication Symposium Proceeding, University of Texas, pp. 124-130, 1992, hereafter the "Vail Article") in view of Osawa et al. (U.S. Patent 5,702,501, hereafter the "Osawa Patent") and Gonczy et al. (U.S. Patent 4,615,875, hereafter the "Gonczy Patent"). Claim 4 stands rejected under 35 U.S.C. § 103(a) as unpatentable over the Vail article in view of Langer et al. (U.S. Patent 6,155,331, hereafter the "Langer Patent").

In view of the present amendment, Applicants respectfully traverse the Examiner's rejections and request reconsideration and allowance of the claims for the following reasons.

C. Applicant's Arguments

A prima facie case of obviousness requires a showing that the scope and content of the prior art teaches each and every element of the claimed invention, and that the prior art provides some teaching, suggestion or motivation to combine the references to produce the claimed invention. In re Oetiker, 24 U.S.P.Q.2d 1443 (Fed. Cir. 1992); In re Vaeck, 20 U.S.P.Q.2d 1438 (Fed. Cir. 1991). In this case, the Examiner has failed to establish a prima facie case of obviousness against Applicants' claimed invention because neither the Vail Article, the Osawa Patent, the Gonczy Patent nor the Langer Patent, either alone or in combination, teach or suggest, that "the oxide ceramics reinforcing liquid is impregnated in a pressure reduced vessel" as recited in independent claims 1 and 9.

i. The Vail Article

The Vail Article discloses a selective laser sintering process to realize strengths (See Abstract of the Vail Article), wherein laser sintering is performed before impregnation, at air and bed temperatures below 100 °C (See Table 5). Furthermore, after infiltration (analogous to the impregnation claimed in the present invention), the Vail Article discloses firing at no

more than 400 °C to remove moisture (page 126, see paragraph titled "*Post-Processing of SLS Parts*"). The Vail Article also discloses firing some samples at higher temperatures in accordance with the firing cycle shown in Figure 1. However, the Vail Article does not teach, or even suggest, firing to achieve sintering.

As admitted by the Examiner, the Vail Article does not teach, or even suggest, (1) "sintering the impregnated ceramic core in an atmosphere at 1100 degrees centigrade or more" and (2) "the impregnated ceramic core is placed in heat-resistant powder to prevent the impregnated ceramic core from deforming" as recited by independent claims 1 and 9 (Office Action, dated April 3, 2007, at 2, lines 17-18).

However, these are not the only deficiencies in the disclosure of the Vail Article. The Vail Article also does not teach, or suggest, (3) "the oxide ceramics reinforcing liquid is impregnated in a pressure reduced vessel" as recited by independent claims 1 and 9. The Vail Article also does not teach, or suggest, that (4) "the ceramics reinforcing liquid is an inorganic binder, and during impregnation of the ceramic core the inorganic binder smoothly replaces air in the ceramic core" as recited in claims 5 and 11, that (5) "impregnation of the ceramic core with inorganic binder occurs over about 5 to 10 minutes" as recited by claims 6 and 12, and the method embodiment that includes (6) "confining the ceramic core in wax and then forming a heat-resistant shell around the ceramic core confined in wax" as recited by claims 8 and 14.

ii. <u>The Osawa Patent</u>

The Osawa Patent discloses a "clayish composition for molding shaped article of noble metal and method for production of sintered article of noble metal" wherein the clayish composition consists essentially of a noble metal powder, starch and a water-soluble cellulose resin as organic binder and water (See Abstract of the Osawa Patent). The Osawa Patent

discloses that the contents of the starch and the water-soluble cellulose resin each fall in the range of 0.02-3.0% by weight, based on the total amount of the organic binder and the noble metal powder (See Abstract). The Osawa Patent also discloses a method for producing the sintered article of noble metal that consists essentially of a step for producing the clayish composition mentioned above, a step of molding the clayish composition in a desired shape, a step of drying the molded article and a step of sintering the dried molded article (See Abstract). However, the Osawa Patent does not teach, or suggest, impregnating binder into a ceramic core. Instead, the Osawa Patent discloses shaping a clayish composition into a desired shape, which may create many voids in the material (col. 3, lines 60-65; and col. 5, lines 8-25).

The Osawa Patent also discloses that in other methods a clayish molded article may be buried in a mass of ceramic powdered so that the ceramic powder may provide support for the article during sintering and heating (col. 2, lines 23-34). However, the Osawa Patent further discloses that methods employing such a ceramic powder for support are undesirable because they require a great amount of energy for sintering and the method is plagued by uneven sintering due to non-uniform temperatures (col. 2, lines 35-44).

The Osawa Patent also does not teach, or even suggest, (1) "sintering the impregnated ceramic core in an atmosphere at 1100 degrees centigrade or more," and (2) "the oxide ceramics reinforcing liquid is impregnated in a pressure reduced vessel" as recited by independent claims 1 and 9. The Osawa Patent also does not teach, or suggest, that (3) "the ceramics reinforcing liquid is an inorganic binder, and during impregnation of the ceramic core the inorganic binder smoothly replaces air in the ceramic core" as recited in claims 5 and 11, that (4) "impregnation of the ceramic core with inorganic binder occurs over about 5 to 10 minutes" as recited by claims 6 and 12, and the method embodiment that includes (6)

"confining the ceramic core in wax and then forming a heat-resistant shell around the ceramic core confined in wax" as recited by claims 8 and 14.

iii. The Gonczy Patent

The Gonczy Patent discloses a "process for preparing high purity alpha-alumina" that is a high purity alumina with a low sodium content and with a friable, easily ball milled structure produced through a modified sol-gel procedure that includes digestion of the contaminant containing aluminum metal with hydrochloric acid in the presence of excess aluminum, removal of the contaminants, seeding the resulting sol with high purity alumina, drying to a solid, and then calcining the seeded sol solids to produce high purity alpha alumina (See Abstract of the Gonczy Patent). The Gonczy Patent does not pertain to any kind of ceramic and has no relevance to the subject matter of the claims of the above-captioned application. Instead, the Gonczy Patent pertains to processing alumina to make substrate chips for circuitry substrates used on computers, switches and calculators (col. 1, lines 6-12).

The Examiner relies upon the Gonczy Patent to teach, or suggest, "sintering...in an atmosphere at 1100 degrees centigrade or more" as recited in independent claims 1 and 9 of the present application (Office Action, dated April 3, 2007, at 2, line 19, to at 3, line 4). However, the Gonczy Patent, which does not pertain to any type of ceramic, discloses calcining (not sintering) seeded alumina sol product (a metal, not a ceramic) at 1200°C to effect a change in the phase of the metal to the alpha phase. A person of ordinary skill in the art would know that the "alpha phase" is a structure of a metal and not of a ceramic.

In sum, the Gonczy Patent discloses calcining alumina (a metal) at 1200°C to effect a transformation in metal phase to the alpha phase. The Gonczy Patent does not teach, or suggest, sintering a ceramic at 1200°C as the Examiner contends. In fact, the Gonczy Patent

is not even relevant to the art of manufacturing a ceramic core.

iv. The Langer Patent

The Langer Patent discloses a "method for use in casting technology," and in particular relates to a method for the rapid production of dead molds and cores for the casting practice without using master molds (col. 1, lines 4-6). The Langer Patent fails to make up any of the deficiencies in the disclosures of the Vail Article, the Osawa Patent, and the Gonczy Patent.

v. Summary of the Disclosures

The Gonczy Patent is not relevant to the subject matter of the present invention because this patent pertains to the processing of alumina for electronic circuitry and has absolutely nothing to do with manufacturing a ceramic core. Thus, the Gonczy Patent is not only non-analogous art, it is completely irrelevant to the subject matter of the present claims.

The Vail Article, the Osawa Patent, the Gonczy Patent and the Langer Patent, either alone or in combination, still fail to teach, or suggest, (1) "sintering the impregnated ceramic core in an atmosphere at 1100 degrees centigrade or more" as recited in independent claims 1 and 9; (2) "the oxide ceramics reinforcing liquid is impregnated in a pressure reduced vessel" as recited by independent claims 1 and 9; (3) "the ceramics reinforcing liquid is an inorganic binder, and during impregnation of the ceramic core the inorganic binder smoothly replaces air in the ceramic core" as recited in claims 5 and 11; (4) "impregnation of the ceramic core with inorganic binder occurs over about 5 to 10 minutes" as recited by claims 6 and 12; and (5) "confining the ceramic core in wax and then forming a heat-resistant shell around the ceramic core confined in wax" as recited by claims 8 and 14.

For all of the above reasons, the Examiner has not established a prima facie case of

obviousness against claims 1, 2 and 5-14 of the above-captioned application.

III. CONCLUSIOIN

The Examiner has failed to establish a prima facie case of obviousness against Applicants' claimed invention because neither the Vail Article, the Osawa Patent, the Gonczy Patent nor the Langer Patent teach, or suggest, either alone or in combination, multiple elements of the claims including "sintering the impregnated ceramic core in an atmosphere at 1100 degrees centigrade or more" and "the oxide ceramics reinforcing liquid is impregnated in a pressure reduced vessel" as recited by independent claims 1 and 9.

For all of the above reasons, claims 1, 2, and 5-14 are in condition for allowance, and a prompt notice of allowance is earnestly solicited.

Questions are welcomed by the below signed attorney for the Applicants.

Respectfully submitted,

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